PHYTOTOXICOLOGY SECTION
INVESTIGATION
IN THE VICINITY OF
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LOT 11, CONC 13, CHATHAM TWP.
KENT COUNTY, 1990

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KENT COUNTY, 1990

Report prepared by:

Phytotoxicology Section
Air Resources Branch
Ontario Ministry of the Environment

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1 Background

On August 28, 1990, Rick Kucera of the Windsor District M.O.E. office requested that the Phytotoxicology Section conduct a survey around the Riddell Hanna No 1 oil well to determine the degree and extent of damage that may have been caused to a farm field in the vicinity of the well. The well has been operating for decades, and on occasion has been purged by pumping out the brine. In the past the brine was not contained but was deposited directly onto the farm field adjacent to the well. Rod Corea of the Chatham MNR office thought that the last purging may have been as long ago as ten years.

On September 19, 1990, Marius Marsh of the Phytotoxicology Section conducted an investigation of the conditions at the site. Rick Kucera and Rod Corea were also present.

2 Field Observations and Methods

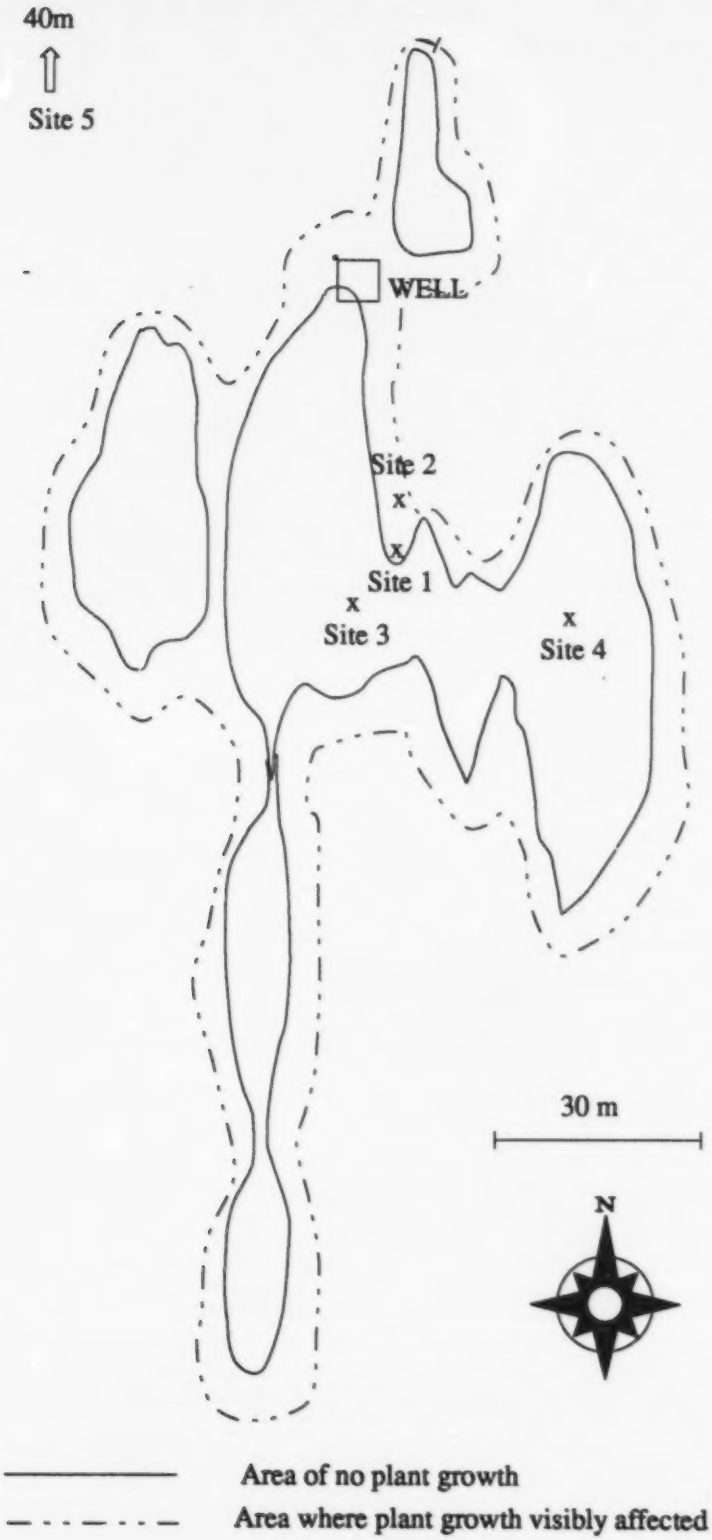
Large patches of bare soil were evident in the soybean field immediately south of the oil well. Soybean growth was visibly affected on a fringe of soil about six meters wide around these bare areas. These areas are shown in Figure 1. The extent of the affected area was determined by measuring the distances with a measuring tape, using the well as a reference point. Figure 1 was compiled from these measurements and from field sketches. The area was determined using a LiCor Area Meter on a cut out of Figure 1.

Effects of the contaminant upon the soybeans were clearly evident in all adjacent areas up to three meters from the bare patches. The soybeans appeared slightly stunted and necrotic up to six meters from the bare areas. The growth in this fringe improved in the direction away from the bare patches. Soybeans in the fringe areas were stunted, although the pods had developed and were ripening. Plants nearest the bare patches had suffered early senescence and had no leaves left. Plants farther from the bare patches had necrotic or partially necrotic leaves. At the time of the investigation, the normal soybean plants were beginning to senesce, which made delineation of the affected area difficult.

Soil samples were taken in duplicate at two sites within the kill area, at two sites in the zone where vegetation was visibly affected, and at one control site. Samples were taken from the 0 - 5 cm, 10 - 15 cm, and, in addition in the kill area, 20 - 25 cm depths using an Oakfield soil corer. Vegetation samples (above ground portion) were taken in duplicate from moderately affected areas and from the control site. All samples were collected using standard Phytotoxicology sampling techniques (O.M.E.,1983). Samples were delivered to the Phytotoxicology Section sample processing laboratory in Toronto where they were dried and ground before being submitted to the Laboratory Services Branch Trace Inorganics Laboratory for chemical analysis. Vegetation samples were separated into shoot (including stem) and pod portions prior to grinding.

The surface 0 - 15 cm soil horizon was a loam soil with large amounts of very fine sands and silts, except at Site 5 which was a sandy loam. At Sites 3 and 4, the soil had a distinct salty taste. At Site 4 a very firm layer was encountered at 15 cm depth which necessitated the use of a shovel for sampling. The soil at depth had a more platy structure as opposed to the weak, fine granular and fine subangular blocky to amorphous structure nearer the surface. At depth, porosity was lower than near the surface with fine, weakly

Figure 1: Location of Salt Affected Soils in the Vicinity of Riddell- Hanna #1 Well



expressed horizontal fractures occurring and very few horizontal or vertical macropores. There was no evidence of earthworms and very few other soil meso or macrofauna. All these factors may be impeding soil internal drainage and are indicative of subsoil compaction.

3 Results

Results from the chemical analyses are presented in the tables below. Table 1 shows the electrical conductivity and the sodium content of the soil samples. Results for other metals are not shown because they showed no indication of contamination in the affected soils. Table 2 shows concentrations of sodium and chloride found in the soybean plants at the three sampling sites.

Table 1: Electrical Conductivity and Sodium Concentrations in Soils in the Vicinity of Riddell-Hanna No 1 Oil Well, Sept 19, 1990. (mean of two samples).

Site	Depth (cm)	Electrical Conductivity (mS/cm)	Sodium (ug/g)
1	0-5	0.429	280
2	0-5	0.169	230
3	0-5	6.28	1500
4	0-5	6.23	1350
5 (control)	0-5	0.066	98
1	10-15	0.523	300
2	10-15	0.307	275
3	10-15	2.35	800
4	10-15	2.75	1500
3	20-25	2.37	895
4	20-25	2.53	1400

Table 2: Sodium and Chloride Concentrations in Soybean in the Vicinity of Riddell Hanna No 1 Well, Sept. 19, 1990.

Site	Tissue	Sodium (ug/g)	Chloride (%)
1	pod	27	0.235
2	pod	8	0.140
5	pod	8	<0.026
1	shoot	420	2.05
2	shoot	80	1.95
5	shoot	25	0.026

4 Discussion and Conclusions

Table 1 clearly shows that a very serious problem exists with salt concentrations in the soils of the affected area. Electrical conductivity, a measure of total soluble salt concentration, exhibits a marked increase in the affected area. OMAF (1988) indicates that a conductivity reading of 1.0 mS/cm would be expected to cause severe damage to most plants. In the affected area, the conductivity reaches six times that level. The data indicates that sodium concentrations in the affected area are considerably higher than those in the control samples. In all cases, the samples from the fringe area where soybeans were growing but showed visible damage, had higher levels than the control, but lower than the area of bare soil. Serious contamination exists in the bare area at depths exceeding 25 cm.

From Table 2, it can be seen that both sodium and chloride concentrations in the plants were higher in the affected area than in the control. Chloride concentrations exceeded two percent in the shoots of plants nearest the bare patch. This is an exceedingly high concentration which is rarely encountered. For comparison purposes, the Upper Limit of Normal (ULN, see appendix) for rural foliage is 0.15%.

The results of this survey clearly indicate that an area of land in the vicinity of the Riddell Hanna No 1 well has been severely affected by salt damage. The soil has been affected to a depth beyond 25cm. The pattern of damage and soil contamination is consistent with the claim that fluids purged from the well have been allowed to contaminate the land in the vicinity of the well. The total affected area was estimated at 7600 m^2, 4,000 m^2 of which does not support any plant life.

5 Appendices

5.1 Explanation of MOE "Upper Limits of Normal" Contaminant Guidelines

Interpretation of concentrations were based on "Upper Limit of Normal" (ULN) guidelines established by the Phytotoxicology Section, Air Resources Branch (OME,1989). The ULN was determined by examining an extensive database for soils and vegetation samples collected at sites removed from any point source of contamination. Statistical tests were applied to the data to calculate the ULN value. This ULN value would not normally be exceeded in 99 samples in 100 for background areas. Values which exceed the ULN are considered likely to have resulted from contamination. Values which exceed the ULN do not necessarily imply that the element is toxic at that level. Concentrations which are below the guidelines are not known to be toxic.

It is stressed that the ULNs do not represent maximum desirable or allowable levels of contaminants, but rather serve as guidelines which, if exceeded, flag situations requiring further investigation to determine the significance of the above normal concentrations. Comparisons of sample elemental concentrations with those from control or reference areas may also serve to flag such situations at contaminant concentrations lower than the ULNs.

5.2 References

Ontario Ministry of Agriculture and Food, 1988, 1988 Vegetable Production Recommendations. Publication #363.

Ontario Ministry of the Environment, 1983. Field Investigation Manual. Phytotoxicology Section, Air Resources Branch; Technical Support Sections - NE and NW Regions.

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